

Beam Experiments for RHIC Run-4

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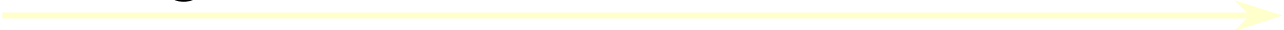
RHIC Beam Experiment Workshop
BNL Science Education Center
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1. Run-4 goals
2. Machine improvements in Run-4
3. Beam experiments that support Run-4
4. Summary

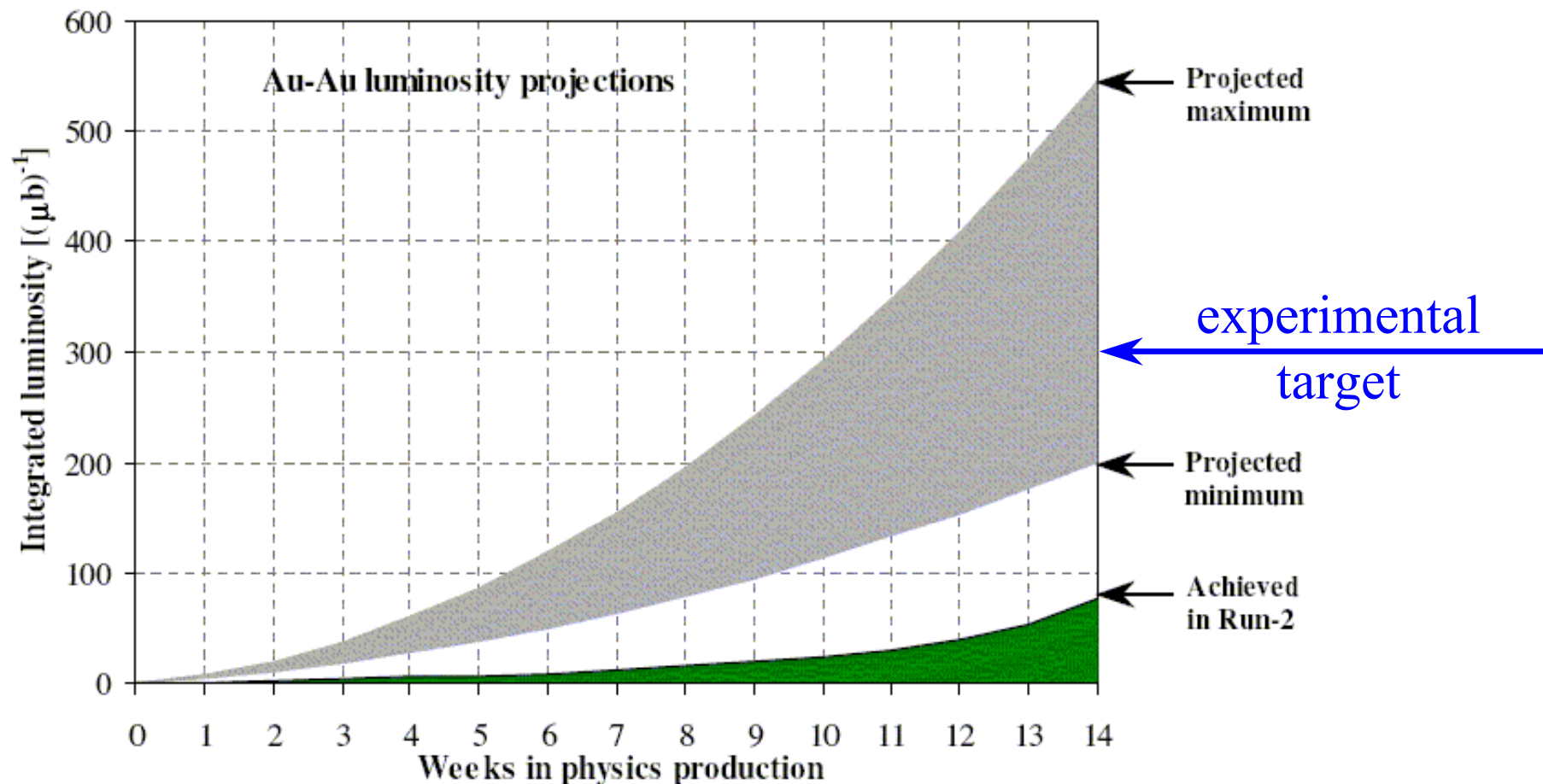
- President's budget allows for 27 weeks of cryogenic operation (need 3 weeks for cool-down and warm-up)
- Run-4 modes:
 1. 5+14 weeks Au-Au at 100GeV/u beam energy, target luminosity of $300(\mu\text{b})^{-1}$ delivered
 2. 5 weeks p \uparrow development (partial warm AGS snake, gas jet, working point)
 3. If 5 more weeks Au-Au at 31GeV/u beam energy (allows comparison with ISR data)
 4. If even 5 more week, p-p luminosity production

- Beam into Blue : 24-Nov-03
Beam into Yellow: 01-Dec-03
- Lattice for Run-4

β^* [m]	IP2-4-6-8-10-12
injection	10-10-10-10-10-10
transition	5-5-5-5-5-5
storage	3-5-1-1-3-5



- 1st time at top rigidity with 2 IRs at $\beta^*=1\text{m}$
- Phobos revised loss threshold for ramp and stores from 300rad/hr to 2000rad/hr

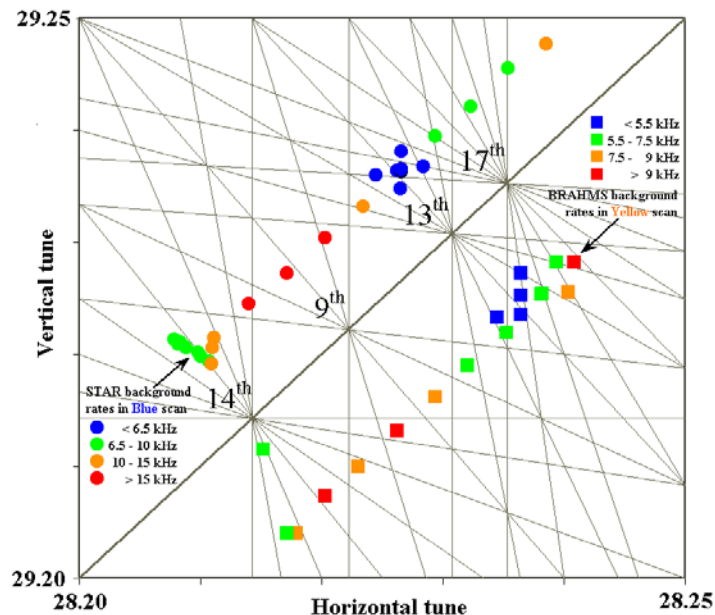


1. Bunch intensity increases
→ Extra bunch merge in Booster (M. Brennan, M. Blaskiewicz, ...)
2. Collimation
→ Secondary collimators in both rings (A. Drees, ...)
3. Shielding
→ More shielding at Phenix and Brahms (K. Yip, ...)
4. Vacuum
→ More baking, NEG coated pipes (D. Hseuh, S.Y. Zhang, ...)
5. BPMs
→ Better TBT data, DX BPMs (T. Satogata, P. Cameron, ...)
6. Reduced recovery and maintenance time
→ Quenches, ice balls, faster down ramps, AtR cooling, ...
(M. Bai, G. Ganetis, D. Bruno, A. Pendzik, ...)
7. Faster and more convenient operations tools
→ Ramp analysis, less clicks, ... (J. van Zeijts, G. Marr, T. Satogata, ...)
→ More automation (steering, collimation, gap cleaning, ...)

- Good understanding of linear optics is essential for smooth machine operation
- Progress in the understanding and correction of the following is helpful (Johannes, Todd, Mei, Rogelio, Rama, ...)
 - Orbit bump closure coefficients
 - Linear coupling (ramp and store)
 - Gradient errors
 - Dispersion errors
- This is also a pre-requisite for a lattice with $\beta^* < 1\text{m}$ at Phenix

- Nonlinear IR errors have significant effect on beam lifetime with $\beta^* \leq 1\text{m}$
 - Only 6σ dynamic aperture in simulation for $b^*=1\text{m}$
 - Tune footprint at $\beta^* \leq 1\text{m}$ dominated by nonlinear IR errors, not beam-beam (Rogelio)
 - Beam-based correction not yet done at $\beta^*=1\text{m}$ and beam energy of $100\text{GeV}/u$
 - Last year's corrector values do not increase the dynamic aperture in simulations
 - Have not used measured magnetic field errors
- Should finish nonlinear IR correction by end of Run-4**

- Once interaction regions are corrected, beam-beam will be the dominant source of nonlinear forces
- Only way to increase the beam-beam limit is to change the working point (Rogelio)



Measurement of background as a function of working point

[Deuteron-gold collisions,
 $\xi / \text{IP} \approx 0.001$, 4 head-on collisions]

- For vacuum problems we need to answer the following questions (S.Y., Dick, ...):
 - Should we replace all warm beam pipes with NEG coated pipes?
 - What is the desorption with beam loss
 - For stainless steel
 - For NEG coated beam pipes
 - Which bunch patterns should we use for bunch numbers between 56 and 112?
 - Do we still need solenoid?

- Experiments target Au-Au luminosity 3x higher than achieved in last run with same running time
- Beam experiments can improve the Run-4 performance in the following areas
 - Linear machine
[Coupling, gradient errors, dispersion]
 - Nonlinear machine
[IR correction, resonance driving terms]
 - Working point
[Beam-beam]
 - Vacuum
[Bunch pattern, NEG coated pipes]